OF INTEREST TO TEACHERS

Biology in Secondary Schools *

By Maurice A. Bigelow

Looking at the problems of high-school biology from the standpoint of the great majority of pupils, not from that of the selected few whose interests or plans may sometimes demand special arrangement of courses, my answer to the Departmental Editor's question, "Should the high-school biology be one based on the conception of biology as a single science, using plant or animal materials as occasion demands for developing principles, or should it be separate sub-courses or entirely distinct courses in botany, zoölogy, or human physiology?" is "yes" for the first part of the question and an emphatic "no" for the second part. And the following considerations point to such a conclusion:

The practical problems of the high-school curriculum, viewed from the standpoint of school administration, demand concentration of the biological work into one course *adapted for the great majority* of pupils. Here are the facts in support of this: (*a*) It is generally admitted that four science courses, one for each year, offer the maximum amount of science desirable for the average secondary-school pupils. (*b*) Chemistry, physics, botany, zoölogy, human physiology, earth science — a total of six — are the sciences which must be taken into consideration. (*c*) There are two possible solutions, namely, election or concentration. (*d*) Election means that pupils will fail to get a broad outlook on the field of natural science, and *possibly of all biology*. (*e*) Concentration of the biological work into one course would leave biology, physics, chemistry, earth science — one for each year of the high school. This looks reasonable from the standpoint of school administration, but is a year in biology satisfactory from the viewpoint of the biologist?

From many quarters we hear the objection that botany and zoology have developed into quite separate sciences; and this statement is true in most colleges where research for the few rather

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than liberal biological training for the many prevails. However, it is now high time that secondary-school teachers of biology begin to distinguish between technical zoölogy and botany viewed as courses leading directly to research and liberal biological courses designated to teach the great ideas or principles of the life sciences with reference to the needs of the average well-educated citizen. Viewed from this standpoint botany and zoölogy are not properly two sciences. And this is the standpoint which should be taken in secondary schools where the great majority of pupils are completing their formal education rather than preparing for college. More than anything else high-school teachers of biology need to study more seriously the problems of teaching the science with reference to the ideals of liberal secondary education considered as an end in itself rather than as college preparation. Viewed in this way the teaching of biology in the secondary school becomes the selection and presentation *not so much of the facts as of the great ideas or principles* which may be drawn from organized study of a series of plant and animal forms, and the unified course in biology becomes a logical necessity.

But from the four winds comes the protest that botany and zoölogy are so vastly rich in materials that even with a year for each they cannot be "finished." I must confess that I have not been able to get into sympathy with this protest. Why should we want to "finish" botany or zoölogy in one year or even in five, so far as secondary education is concerned? We do not "finish" other subjects in the high school. On the contrary we simply select materials for well-rounded year courses. Certainly we cannot complete a wide survey of either of the biological sciences in a single year, but there are great possibilities of selection when our outlook on high-school science becomes that of liberal education as distinguished from technical education. Take any current high-school book on zoölogy or botany and go through the pages critically questioning each paragraph from the point of view of education for general culture and information, and one is amazed at the amount of matter for which little justification is apparent. Eliminating such material of question-

able value, it seems perfectly feasible to combine the essentials, the great ideas, of the two phases of the science of life into a single course. Such a course with its broader outlook would be more valuable to the average educated citizen than would be either botany or zoölogy studied without reference to its sister science. Even laying entirely aside the practical problems of school administration, which are certainly tending to limit biology study to a single year for the average pupils, I believe that ultimately our high schools will adopt a year course in biology because such a course will best include the important values of biology in secondary education.

The above discussion has included only the information side of the values of high-school biological study. Limitations of space forbid appropriate discussion of the scientific discipline derivable from the study; but I fail to see any valid argument against the year in biology as far as discipline is concerned. On the contrary we may expect to get more valuable scientific discipline from the study of the more important subject-matter which would be concentrated into a year of biology. The possible objections all center around the idea that science study must be carried far into useless detail in order to give the best scientific discipline. This may be true from the research standpoint; but as applied to the everyday life of the average cultured citizen the results of such study of details have been far from satisfying. We seem to be moving rapidly towards that science study which is so correlated with information worth having that the discipline obtained will meet with greater application in practical life.

Summary. — The practical problems of the school curriculum seem to demand a course in biology for the majority of pupils, and there is nothing in the content of the science and in approved methods of teaching which opposes this. Considering the recognized values, a course in biology will tend to emphasize the great ideas or principles worth knowing, and there is no inherent reason why scientific discipline should not be as well developed as in any other high-school course in science.

Teachers College.

A paper by Dr. Ernst Friedrich, of the German commercial high school at Leipzig, contains the following interesting facts: The world's lumber trade amounts to $285,600,000 annually, of which the United States furnishes about 20 per cent., Austria-Hungary 19 per cent., Russia 16 per cent., Canada 13 per cent., Sweden 18 per cent., and Finland 10 per cent. Great Britain has but 4 per cent. of forest land; France, Switzerland, Italy, Greece, and Spain each less than 10 per cent. Even the newer countries, Chile, Argentine Republic, and Australia are forced to import wood.

The following abstract of a paper on "The Influence of Environment on the Composition of Wheat" by J. A. LeClerc and Sherman Leavitt, has been taken from one of the summer numbers of *Science:*

"Crops grown from the same seed at three points of widely different climatic conditions, such as Kansas, California, and Texas, forming a so-called triangular experiment, and similarly at South Dakota, California, and Texas, showed a marked difference in the protein content, the weight per bushel, the percentage of starchy grain, and total sugar content. Kansas produced invariably a high protein and California a low protein and high sugar content wheat. Wheat grown in California one year was found to double its protein content when grown in Kansas the next; the reverse was found to be true when Kansas seed was grown in California. These differences are due to climatic conditions. The composition of the soil seems to exert no influence on the composition of the crop."

Science for August 14 states that the appropriation for the Department of Agriculture for the present year is over eleven million dollars. The share of this granted to the Bureau of Plant Industry is larger this year, partly because of the boll-weevil work now being carried on. The appropriation for the introduction of rare seeds and plants from foreign countries was increased to $56,000, in addition to the congressional seed distribution, which is to be continued on the usual basis. The

Forest Service appropriation is also larger than last year. "The provisions of the previous year authorizing the extension of the national forests and the giving of advice to owners of woodlands as to their care were eliminated, but authority to aid other federal bureaus in the performance of their duties in respect to the national forests was granted, and advances of money may hereafter be made to chiefs of field parties for fighting forest fires."

Science for October 2 contains an article by Professor Thomas B. Osborne, of the Connecticut Agricultural Experiment Station, on "Our Present Knowledge of Plant Protein." In 1746, Beccari discovered wheat gluten, which was the only form of vegetable protein known for fifty years; after a sketch of the work done in this field from Beccari's time to the present, Professor Osborne states the results of a series of experiments performed in his own laboratory.

About twenty-five different proteins of vegetable origin, all of them the constituents of seeds, have been identified; some few, however, are also found in the active embryo. These have been assigned to the commonly recognized groups established for animal proteins. *Globulins*, or proteins soluble in solutions of neutral salts but insoluble in water, form the greater part of the reserve protein of all seeds except those of the cereals. *Prolamins*, soluble in alcohol and dilute acids but insoluble in water and saline solutions, occur in quantities in the seeds of most cereals but not in other plants examined. *Glutelins*, soluble in dilute acids and alkalis but insoluble in neutral solutions, constitute a large part of the protein of all the cereals and possibly of other seeds. The only known member of this group accessible to satisfactory investigation is the glutenin of wheat which forms nearly one half of the gluten. *Albumins* are present in very small amounts in nearly all seeds. They are more like the protein of animal origin than are the reserve proteins. *Proteoses* in small amounts have been observed in all seeds examined. No phosphorus-containing proteins similar to those which nourish developing animals have been found.

Of twenty-three different seed proteins which have been hydro-

lyzed, all have yielded leucine, proline, phenylalanine, aspartic acid, glutaminic acid, tyrosine, histidine, arginine, and ammonia. A fairly accurate analysis of arginine, histidine, and lysine has been made but not of most of the amino-acids.

The available data indicate a close connection between the chemical constitution of seed proteins and the biological relations of the plants producing them, though no two seeds are alike in respect to their protein constituents.

JANE R. CONDIT.

A GIFT TO TORREYA

A MEMORIAL TO MRS. JAMES MCMANES

As a memorial to Mrs. James McManes, of Philadelphia, her daughter has given to TORREYA the sum of two hundred dollars to be used for illustrations, beginning with the present number. This generous gift will not only make the magazine more attractive in appearance, but, for the coming year at least, will make it possible to secure many interesting papers for which the authors rightly insist upon illustrations.

Mrs. McManes's interest in botany was well known to her intimate friends; and while it did not definitely influence her larger institutional endowments, it was evidenced by such gifts as the giant cycad which for years has attracted the attention of visitors at the University of Pennsylvania.

NEWS ITEMS

At the University of Kansas, F. U. G. Agrelius has been appointed instructor in botany.

Dr. Homer D. House has been appointed associate director in the Biltmore Forest School.

Mr. R. J. H. DeLoach, of the Georgia Experiment Station, has been made professor of the cotton industry in the Georgia Agricultural College.

Mr. George L. Fawcett was recently transferred from the United States Laboratory at Miami, Florida, to the Experiment Station at Mayaguez, Porto Rico.